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Pursuing Vision Zero in Seattle – Results of a Systemic Safety Analysis

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Systemic Safety Analysis and Vision Zero

Rebecca Sanders, PhD, Toole Design Group
PSU Research Seminar - June 3, 2016

Who Am I?



- Head of Research at Toole Design Group
- PhD in planning
- Focus on bicycle and pedestrian safety
- Years at UC Berkeley SafeTREC
- Now working on
 - Boston Vision Zero
 - Portland Vision Zero
 - Denver Vision Zero
 - **Seattle's Bicycle & Pedestrian Safety Analysis**

Acknowledgements



- UNC
 - Libby Thomas, Dr. Bo Lan - Analysis
- Toole Design Group
 - Michael Hintze – Project Manager
 - Spencer Gardner, Alexandra Frackleton - Maps
 - Courtney Ferris - Graphics
- SDOT
 - Monica Dewald – Project Manager
- Advisor
 - Dr. Robert Schneider

Overview



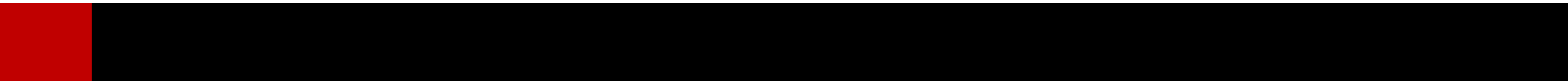
- Vision Zero overview
- Seattle case study
- Key takeaways
- Conclusions



What is Vision Zero?



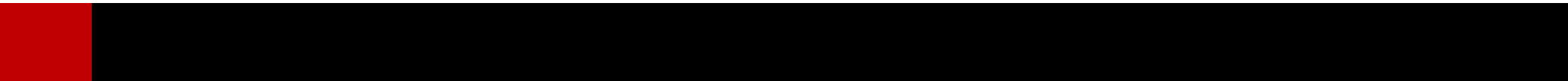
Audacious?



What is Vision Zero?



“Ludicrous”?



An Idea Whose Time Has Come



FOR A SAFER NYC
SPEED LIMIT 25
VISION ZERO



Photo credit: NYCDOT

Nuts & Bolts of Vision Zero



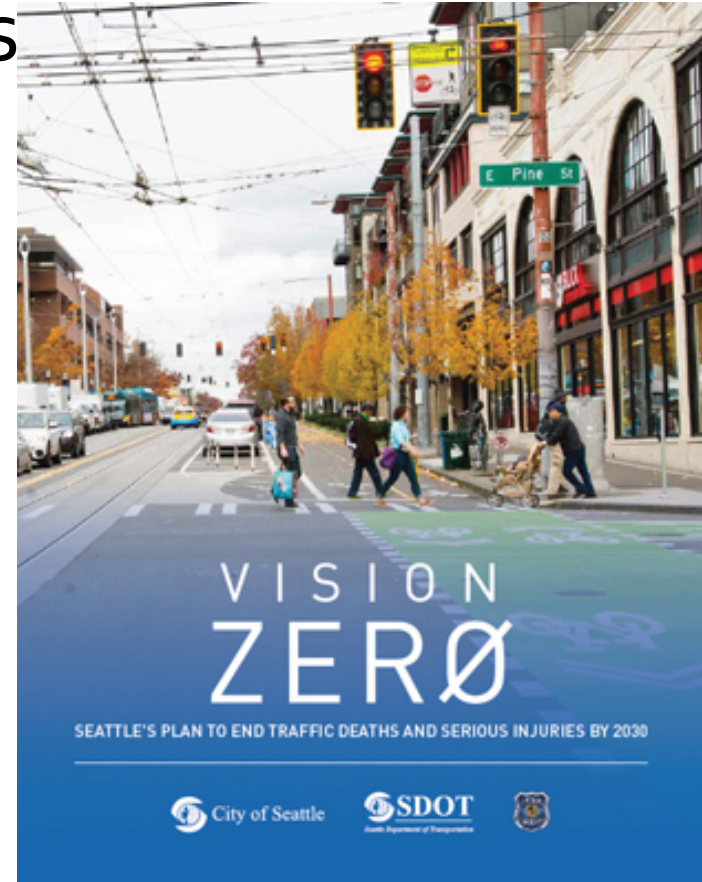
- Goal of zero traffic fatalities
- Driven by families, community organizations
- Counter to traffic death as acceptable
- Push for data-driven methods
- Push for equity considerations



Vision Zero in Seattle

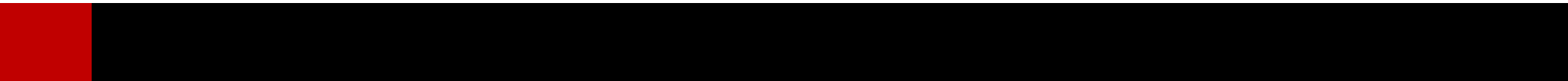


- 668, 342 people in 83.9 sq. miles
- Nearly 20 deaths & 150 serious injuries/year
- **End traffic deaths & serious injuries by 2030**
- Bicycle & Pedestrian Safety Analysis





**Proactively identify locations and
prioritize safety improvements
with the goal of preventing
future crashes**



Bicycle & Pedestrian Safety Analysis



- Summary statistics (2007-2014 SDOT data)
- Identification of crash types
- Multivariate analysis to understand risk factors
 - Exposure estimation
- Crash type-based countermeasure development
- Prioritization/ranking of high risk locations (Safety Performance Functions)
- Analytical tool development



Hotspot Analysis

- Explores patterns between crashes
- Uses crash-based database
- Benefits from control for exposure

Systemic Safety Analysis

- Investigates how combinations of features are associated with crashes
- Uses intersection- or segment-based database
- Needs exposure information

Safety Analysis



Hotspot Analysis

- Explores patterns between crashes
- Uses crash-based database
- Benefits from control for exposure

Systemic Safety Analysis

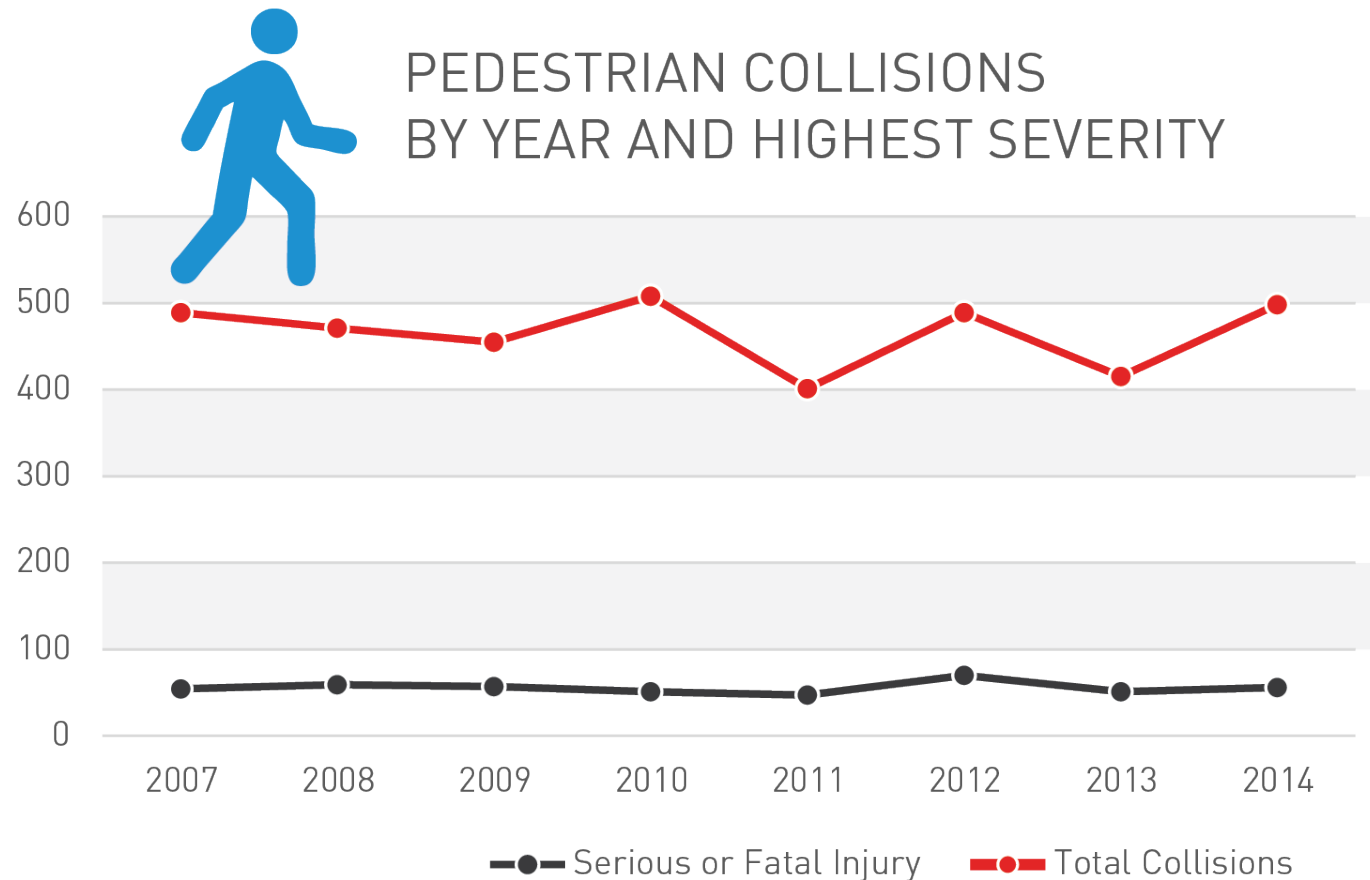
- Investigates how combinations of features are associated with crashes
- Uses intersection- or segment-based database
- Needs exposure information

Seattle's Pedestrian Crashes



2007-2014

- 3,726 pedestrian crashes
- 445 serious or fatal crashes



Actions for Pedestrian Crash Types



Pedestrian

- Intersection crossing
 - With signal
 - No signal
 - Against signal
- Midblock crossing
- Walking in roadway
 - With traffic
 - Against traffic

Driver

- Going straight
- Turning left
- Turning right
- Backing
- Stopped in roadway

Common Pedestrian Crashes



VEHICLE GOING STRAIGHT / PEDESTRIAN CROSSING



Approximately

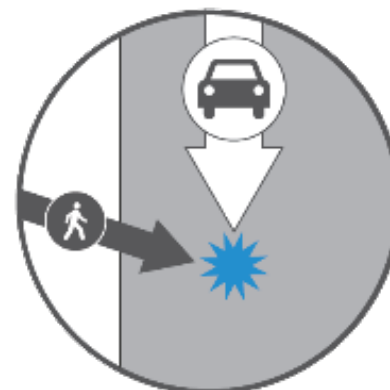
1 in 4

total crashes

1 in 3

Serious or fatal crashes

VEHICLE GOING STRAIGHT / PEDESTRIAN CROSSING MIDBLOCK



Approximately

1 in 5

total crashes

1 in 3

Serious or fatal crashes

LEFT HOOK



Approximately

1 in 3

total crashes

1 in 5

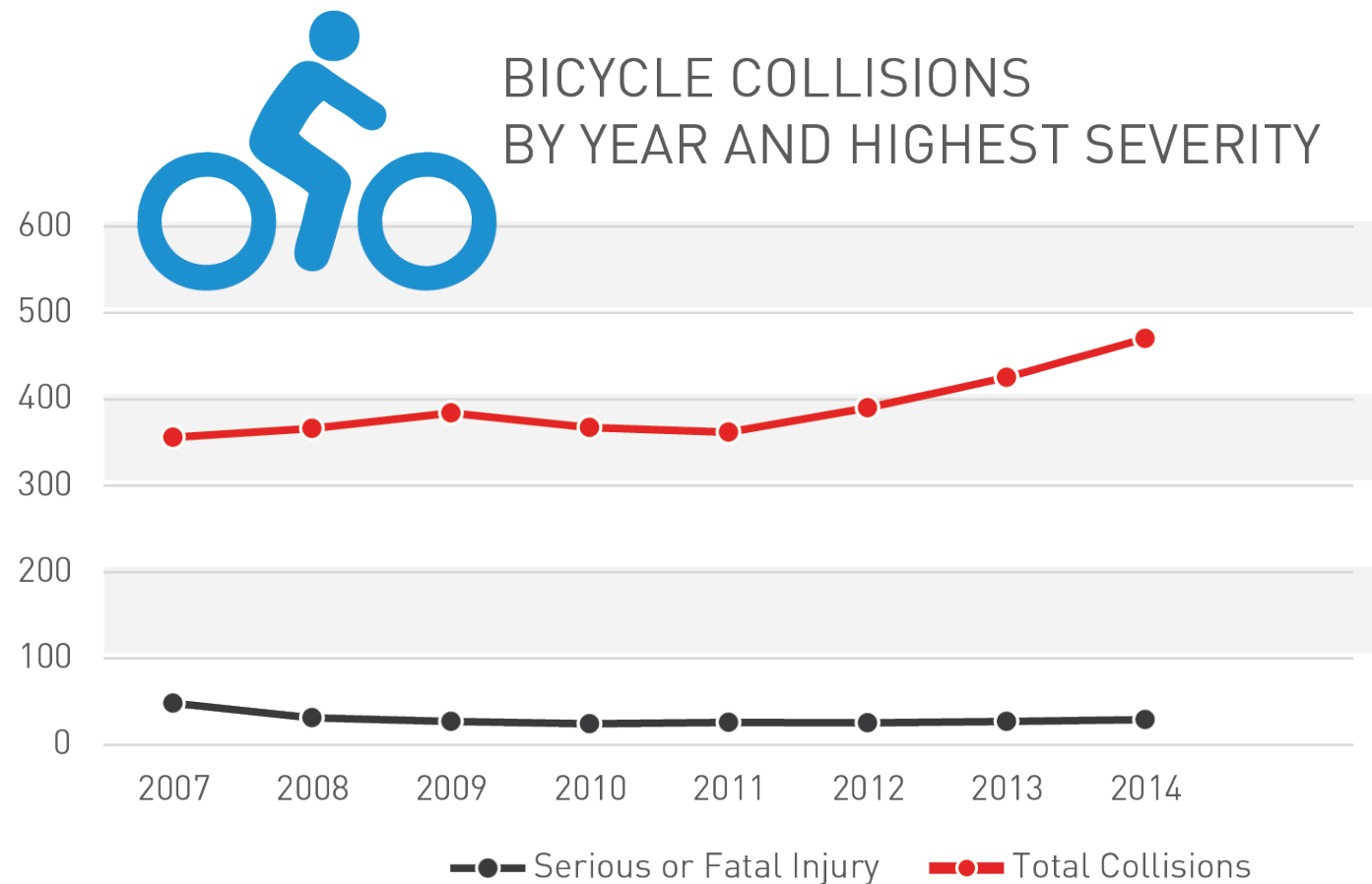
Serious or fatal crashes

Seattle's Bicycle Crashes



2007-2014

- 3,120 bicycle crashes
- 237 serious or fatal crashes



Actions for Bicycle Crash Types



Bicyclist

- Riding with traffic
- Riding against traffic
- Entering/crossing roadway
- Crossing diagonally
- Turned into vehicle path
 - Same direction
 - Opposite direction

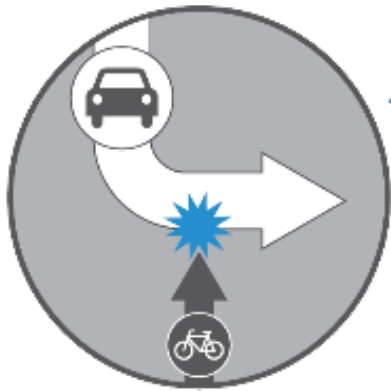
Driver

- Going straight
- Turning left
- Turning right
- Backing
- Stopped in roadway

Common Bicycle Crashes



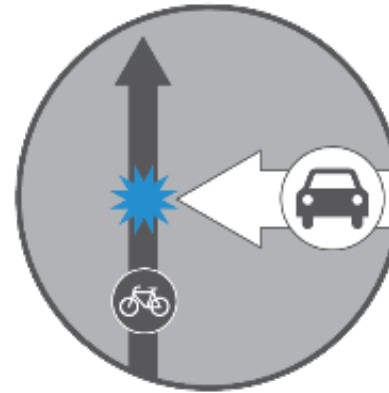
LEFT HOOK



Approximately
1 in 7
total crashes

1 in 5
Serious or fatal crashes

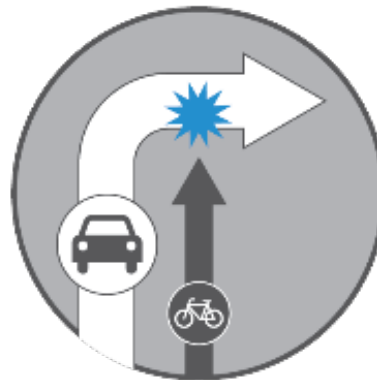
ANGLE



Approximately
1 in 11
total crashes

1 in 10
Serious or fatal crashes

RIGHT HOOK



Approximately
1 in 14
total crashes

1 in 36
Serious or fatal crashes

Bike & Pedestrian Crashes in Context



Total Crashes

% of All Crashes
by Mode



Severity of Crashes

% of Serious Crashes
by Mode

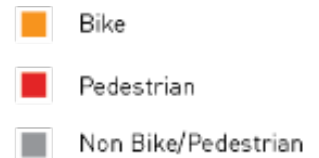


% of Fatal Crashes
by Mode



0

100



Bike & Pedestrian Crashes in Context



Total Crashes

% of All Crashes
by Mode



Severity of Crashes

% of Serious Crashes
by Mode



% of Fatal Crashes
by Mode



Bike & Pedestrian Crashes in Context



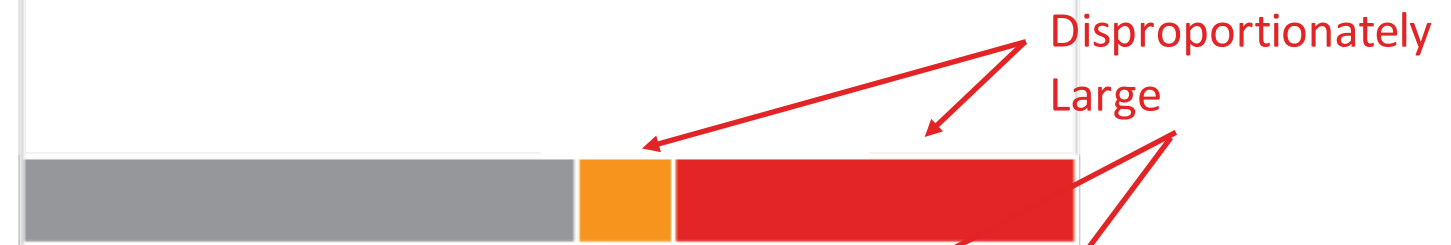
Total Crashes

% of All Crashes
by Mode

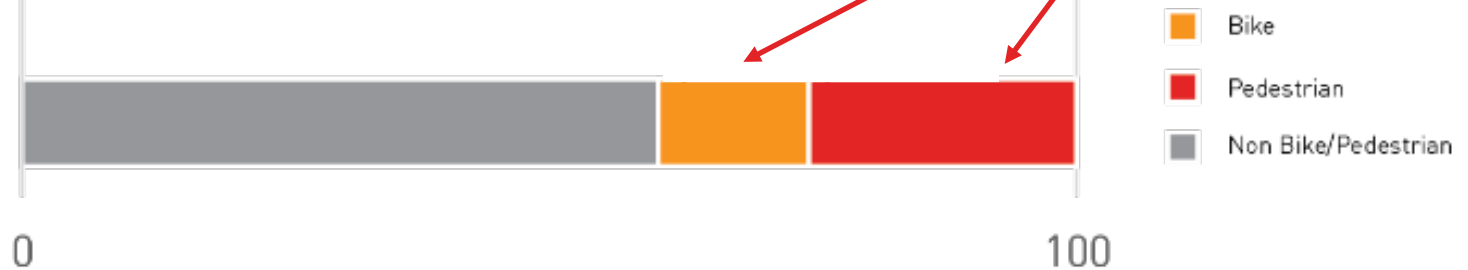


Severity of Crashes

% of Serious Crashes
by Mode



% of Fatal Crashes
by Mode



Safety Analysis



Hotspot Analysis

- Explores patterns between crashes
- Uses crash-based database
- Benefits from control for exposure

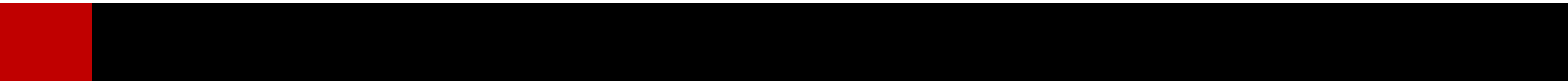
Systemic Safety Analysis

- Investigates how combinations of features are associated with crashes
- Uses intersection- or segment-based database
- Needs exposure information

Variables of Interest



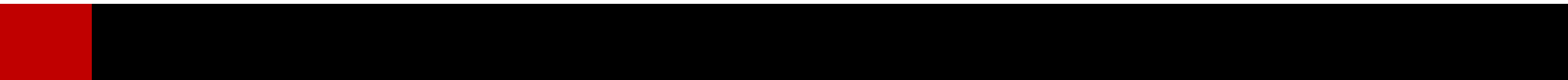
- Roadway classification
- Number of lanes
- Land uses
- Pedestrian and bicycle volumes
- Topography
- Roadway operations



Ballpark Exposure Estimation



- Pedestrian model
 - # HH in 0.25-mi radius of intersection
 - # commercial properties in 0.25-mi radius of intersection
 - Intersection located w/i 0.25 mile of university



Ballpark Exposure Estimation



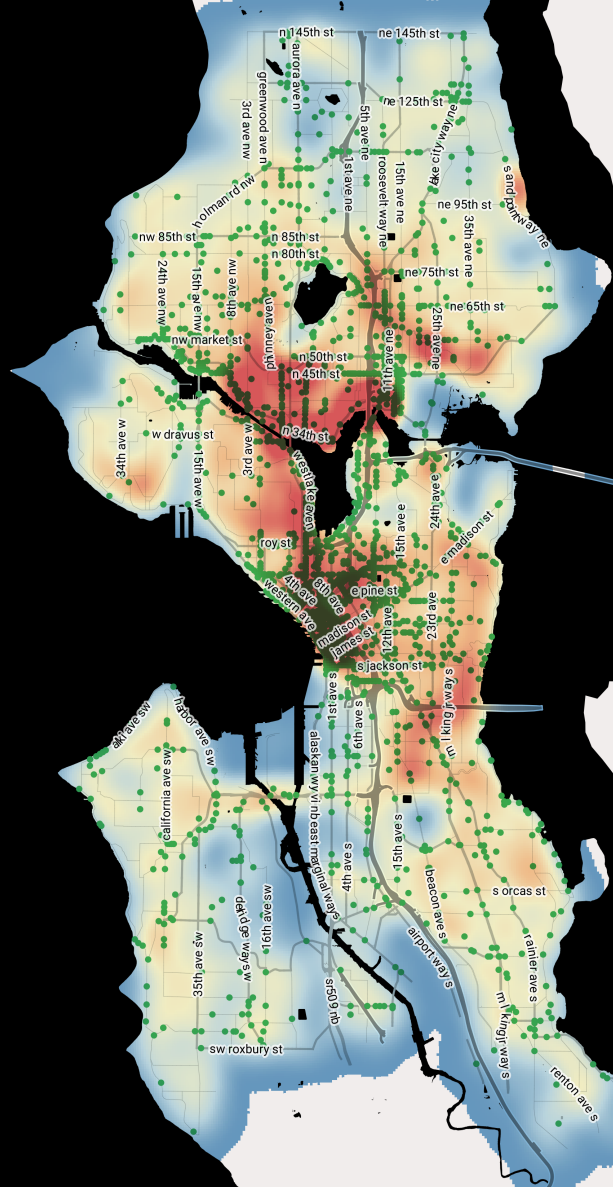
- Bicyclist model
 - # bike lanes on street segment
 - Sq. root of network distance to a university

Ballpark Exposure Estimation



- Bicyclist model
 - # bike lanes on street segment
 - Sq. root of network distance to a university
 - **AADT Strava count**

Exposure Estimation



Cyclist
exposure & crashes



Pedestrian
exposure & crashes



Intersection Models for:

- Total bike crashes
- Opposite direction bike crashes
- Angle bike crashes
- Total pedestrian crashes
- Pedestrian crossing, driver straight

Systemic Safety Analysis



- Produced safety performance functions

$$Y = \text{Exp}(B_0 + x_1 B_1 + x_2 B_2 + \dots + x_k B_k)$$

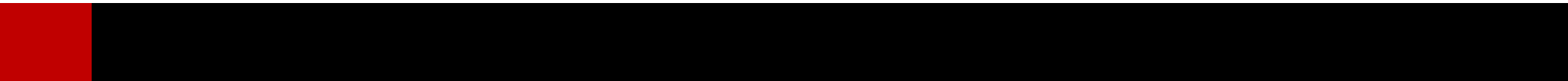
- Used to predict where crashes are most likely to occur in the future*

*Standard caveats apply!



Ranked four ways:

- Crash history
- Predicted crashes
- Empirical Bayes (50/50)
- Potential Safety Improvement
(EB - predicted)




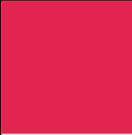


Why this Matters



EXAMPLE Ranking






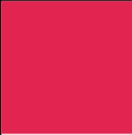
Bike Opposite Direction Crashes	
Top crashes as ranked by combination of predicted and reported numbers of OD crashes (EB)	Top crashes as ranked by predicted number of OD crashes
	
	
Top crashes as ranked by potential safety improvement (PSI)	Top crashes as ranked by reported numbers of OD crashes

For illustrative purposes only



EXAMPLE Ranking



Bike Opposite Direction Crashes	
Top crashes as ranked by combination of predicted and reported numbers of OD crashes (EB)	Top crashes as ranked by predicted number of OD crashes
	
	
Top crashes as ranked by potential safety improvement (PSI)	Top crashes as ranked by reported numbers of OD crashes

For illustrative purposes only



EXAMPLE Interpretation

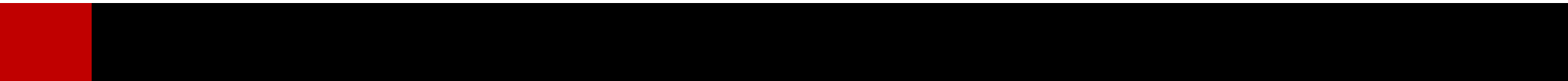


Bike Opposite Direction

- Protected left turns
- Prohibit left turns
- Pocket lefts

Ped Crossing, Driver Straight

- Signal
- RRFB




EXAMPLE Interpretation



Bike Opposite Direction

Ped Crossing, Driver Straight

- 
- Protected left turns
 - Prohibit left turns
 - Pocket lefts
 - **Road diet**

- Signal
- RRFB
- **Traffic calming**
- **Road diet**

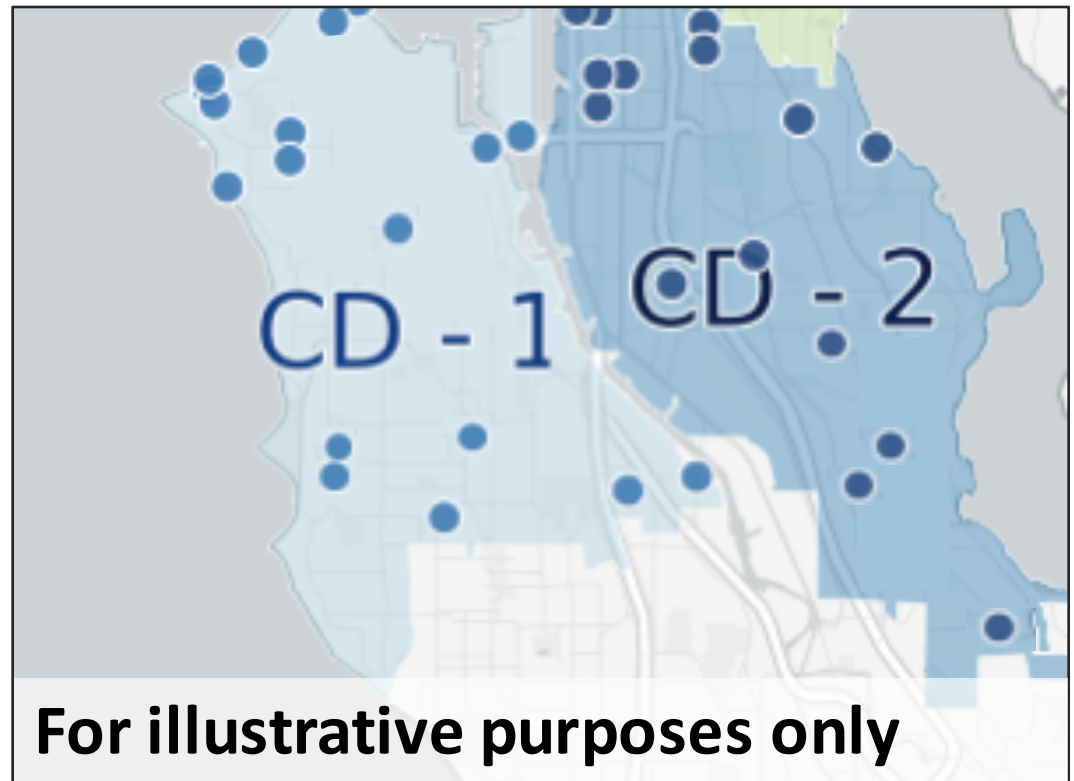
EXAMPLE Use for Geographic Equity



Geographies of Interest

- Council Districts
- Neighborhoods
- Census Tracts
- Communities of Concern

Example Rankings by Council District



Caveats for Crash Data



Overall, SDOT has very high quality data

- Many records were missing actions
- Ancillary codes not always explanatory
- Some codes displayed inconsistency
- Some codes not optimal

Key Takeaways for Other Cities



Critically important:

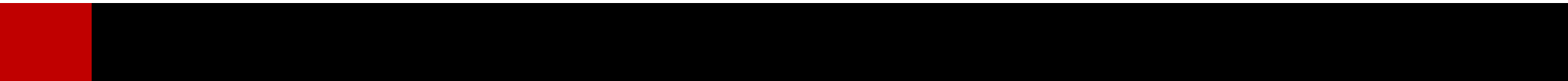
Data quality & availability

Time/resources to perform analyses

Knowledge to analyze data, interpret results

Also important:

Plan to use information



Conclusions



- Systemic analysis offers exciting potential
- Hotspot analysis still important
- Quality data more critical than ever
- Vision Zero is a potential game-changer

